Index

S. No.	Name of the Experiment	Page No.	Date of Experiment	Date of Submission	Remarks
1	Preparing 0.1 N standard Oxalic acid solution	2			
2	Preparing 0.1 N standard Na_2CO_3 solution	3			
3	Titration of H_2SO_4 sol^n by standard Na_2CO_3 sol^n	4			
4	Titration of NaOH sol^n by standard HCl sol^n	5	7/11/2023		
5	Titration of $KMnO_4$ sol^n by standard $H_2C_2O_4$ sol^n	6	14/11/2023		
6	pH determination of given acid/base solution	8	28/11/2023		

Date _____

Expt. No. _____ Page No. 01

Laboratory Discipline

1] Maintainence of discipline inside the laboratory is very essential.
2] Work more than talk, keep silence in the laboratory.
3] Clean apparatus and working place after finishing experiment and put apparatus and reagent bottles in their proper place.
4] Never use the same glass tube for different reagents without washing thoroughly.
5] Never keep gas valve or water tap open.
6] Never keep reagent bottle open, specially Ammonia.
7] Dispose off all waste materials in proper place.
8] Reagent bottles should always be kept and handled properly.
9] Carefully handle glassware apparatus.

Safety Precaution

1] Wear laboratory coat, mask, shoes, goggles while conducting experiments and practicals.
2] Never play with chemicals and do not taste them.
3] Never pour water into concentrated acids, if needed, pour slowly with constant stirring.
4] Never inhale the vapours or gases directly.
5] Always read the label of reagent bottle carefully before adding reagents.

Teacher's Signature _____

Date _____

Expt. No. 01 Page No. 02

Aim: To prepare a standard solution of Oxalic acid of 0.1 N in 250 ml.

Theory: Oxalic acid is a primary standard whose molecular formula is $(COOH)_2 2H_2O$, hence it's molecular mass is 126. It's equivalent mass is $126/2 = 63$ because it's a dibasic acid. So, 1000 ml 1N solution of Oxalic acid contain = 63 g

1 ml 1N solution of Oxalic acid contain = $63/1000$ g

250 ml .1N solution of Oxalic acid contain = $63 \times 250 \times 0.1/1000$

= 1.57 g Oxalic acid

Apparatus: Digital balance, Weighing bottle, volummetric flask (250 ml), Funnel, wash bottle, beaker.

Procedure:

1] Switch on the digital balance and clean and dry the weighing bottle.

2] Take approximately 2 grams of Oxalic acid in weighing bottle.

3] Weigh the weighing bottle with Oxalic acid accurately and record the weight as W_1 g.

4] Now transfer approximately 1.57 g of Oxalic acid in the volumetric flask carefully. with help of funnel.

5] Now, again weigh the weighing bottle with remaining Oxalic acid and record W_2 weight.

6] Add distilled water to the volumetric flask taking care that no Oxalic acid is adhered to funnel and flask. Stir the flask to dissolve and make up the water up to the mark.

Observation and Calculation:

Weight of the weighing bottle with Oxalic acid (W_1) = 22.46 g

Weight of the weighing bottle with Oxalic acid after transfer (W_2) = 20.88 g

Weight of tranferred Oxalic acid $(W_1 - W_2)$ = 1.57 w gm

Therefore, the normality standard solution of Oxalic acid [If 'W' gram substance of Equivalent mass 'E' is dissolved in 'V' ml of the solvent] = $\frac{W}{E} \times \frac{1000}{V}$

$= \frac{1.57}{63} \times \frac{1000}{250}$

$= 0.01$ N

Teacher's Signature _____

Date

Expt. No. 02 Page No. 03

Aim: To prepare a standard solution of Sodium Carbonate of 0.1 N in 250 ml.

Theory: Sodium Carbonate is a primary standard whose molecular formula is Na_2CO_3, hence it's molecular mass is 106. So, it's equivalent weight is $106/2 = 53$, because it's dibasic.

So, 1000 ml 1N solution of Oxalic acid contain = 53 g

1 ml 1N solution of Oxalic acid contain = $53/1000$ g

250 ml .1N solution of Oxalic acid contain = $53 \times 250 \times 0.1 / 1000$

= 1.325 g of Na_2CO_3

Apparatus: Digital balance, Weighing bottle, Volumetric flask (250 ml), Funnel, wash bottle, beaker.

Procedure:

1] Switch on the digital balance and clean and dry the weighing bottle.

2] Take approximately 2 g of Na_2CO_3 in the weighing bottle.

3] Weigh the weighing bottle with Na_2CO_3 accurately and record W_1 g of weight.

4] Now transfer approximately 1.325 g Na_2CO_3 in the volumetric flask carefully with the help of funnel.

5] Now, again weigh the weighing bottle with remaining Na_2CO_3 and record W_2 weight.

6] Add distilled water to the volumetric flask taking care that no Na_2CO_3 is adhered to funnel or flask. Stir the flask to dissolve and make up water up to the mark.

Observation and Calculation:

Weight of Weighing bottle with Na_2CO_3 (W_1) = 25.66 g

Weight of Weighing bottle with Na_2CO_3 after trasfer (W_2) = 24.6 g

Weight of transferred Na_2CO_3 ($W_1 - W_2$) = (25.66 − 24.6) g = 1.06 g

Therefore, the normality of standard solution of Na_2CO_3 [If 'W' gram substance of equivalent mass 'E' is dissolved in 'V' ml of the solvent] = $\frac{W}{E} \times \frac{1000}{V}$

$= \frac{1.06}{53} \times \frac{1000}{250}$

$= 0.08$ N

Teacher's Signature

Date _____

Expt. No. 03 Page No. 04

Aim: To determine the strength of sulphuric acid solution by titrating with a standard Sodium Carbonate solution (N/10).

Theory: Though Sodium Carbonate is a salt, it behaves as a weak base which reacts with Sulphuric acid as follows — $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$ ✓

Therefore, the strength of H_2SO_4 sol^n can be determined by titrating against a standard sol^n of Na_2CO_3 using Methyl Orange as indicator. Normality (N_1) of the H_2SO_4 sol^n is determined by using the relationship — $\boxed{V_1 N_1 = V_2 N_2}$

[V_1 = Volume of H_2SO_4 sol^n, V_2 = Volume of Na_2CO_3 sol^n with N_2 normality] The g/l of the H_2SO_4 is calculated from the relationship — $\boxed{\text{Strength in g/l} = \text{Normality} \times \text{Eq. mass. } H_2SO_4}$

Procedure:

1] Wash and rinse and then fill burette with H_2SO_4 sol^n, record initial reading.

2] Pipette out 10 ml standard Na_2CO_3 sol^n into titration flask, add 2 drops of Methyl Orange.

3] Place flask on clean observable surface and run the acid from burette slowly into it with constant shaking.

4] Record the final reading exactly when colourless sol^n changes to light yellow. Repeat the procedure until we get 3 concordant readings.

Observations: The strength of standard Na_2CO_3 sol^n (N_2) = N/10 = 0.1 N

The volume of Na_2CO_3 sol^n for each titration (V_2) = 10 ml

Indicator = Methyl Orange

Burette readings in ml*

Sl.no	Initial reading	Final reading	Difference reading	Concordant reading
1	0	7.1	7.1	
2.	7.1	14.2	7.1	7.1
3	14.2	21.2	7	

Volume of H_2SO_4 sol^n from burette reading (V_1) = 7.1 ml ✓

Calculation: We have, $V_1N_1 = V_2N_2 \Rightarrow 7.1 \times N_1 = 0.1 \times 10 \Rightarrow 7.1N = 1$

$\Rightarrow N = \frac{1}{7.1} \Rightarrow N = 0.14$ ✓

Result: The strength of the given H_2SO_4 sol^n is 0.14 N.

The strength of H_2SO_4 sol^n in g/l = $0.14 \times \frac{98}{2}$ = 6.86 g/l

[Normality × Eq. mass]

21/12/23

Teacher's Signature _____

Date 07/11/2023

Expt. No. 04 Page No. 05

Aim: To determine the strength of a Sodium Hydroxide solution by titrating with a standard Hydrochloric acid solution (N/10).

Theory: Sodium Hydroxide is a strong base and Hydrochloric acid is a strong acid, they react as follows — $NaOH + HCl \longrightarrow NaCl + H_2O$

Therefore, the strength of NaOH sol^n can be determined by titrating against a standard HCl sol^n using Phenolphthalein as indicator, normality (N_1) of the NaOH sol^n is determined by using the relationship — $\boxed{V_1N_1 = V_2N_2}$

[V_1 = Volume of NaOH sol^n, V_2 = Volume of HCl sol^n, N_2 = Normality of HCl sol^n]

$\boxed{\text{Strength in g/L} = \text{Normality} \times \text{Equivalent mass of NaOH}}$

Procedure:
1] Wash and rinse then fill burette with standard HCl sol^n, record initial reading.
2] Pipette out 10 ml given NaOH sol^n into conical flask, add 1 drop Phenolphthalein.
3] Place the flask on clean observable surface and run the acid from burette slowly into it with constant shaking.
4] Record final reading exactly when colourless solution changes to light pink colour just disappears.
Repeat the procedure until 3 concordant readings are not

Observations: The strength of given HCl sol^n (N_2) = N/10 = 0.1 N

The volume of HCl sol^n for each titration (V_2) = 10 ml

Indicator = Phenolphthalein

Sl no:	Initial reading	Final reading	Difference reading	Concordant reading
1	0	8	8	
2	8	16.2	8.2	8.2
3	16.2	24.2	8.2	

Burette readings in ml*

Volume of NaOH sol^n (V_1) =

Calculation: We have, $V_1N_1 = V_2N_2 \Rightarrow 10N_1 = 8.2 \times 0.1$

$\Rightarrow N_1 = \frac{0.82}{10}$

$\Rightarrow N_1 = 0.082$ N

Result: The strength of given NaOH sol^n is 0.082 N

The strength of given NaOH sol^n in g/L (Normality x Eq. mass) = 0.082×40

$= 3.28$ g/L

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Date 14/11/2023

Expt. No. 05 Page No. 06

Aim: To determine the strength of the given $KMnO_4$ sol^n by titrating against N/10 standard Oxalic acid sol^n.

Theory: Potassium Permanganate oxidises Oxalic acid in the presence of H_2SO_4 to CO_2, neutralization ends when self indicator $KMnO_4$ purple colour is discharged, hence no indicator is necessary.

$$2KMnO_4 + 3H_2SO_4 + 5H_2C_2O_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O$$

Reduction half reaction – $KMnO_4 \rightarrow K^+ + MnO_4^-$

Oxidation half reaction – $H_2C_2O_4 \rightarrow 2H^+ + C_2O_4^{2-}$

In acidic medium, $\{MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O\} \times 2$ (Reduction)

$+ \quad \{C_2O_4^{2-} - 2e^- \rightarrow 2CO_2\} \times 5$ (Oxidation)

$$2MnO_4^- + 16H^+ + C_2O_4^{2-} \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2$$

Since 5 electrons are utilized for the reduction of molecule of $KMnO_4$, therefore the equivalent mass of $KMnO_4$ is 1/5 of it's molecular mass. Hence g/L of $KMnO_4$ is calculated by determining the Normality of the sol^n by titrating against Oxalic acid N/10 sol^n using the relationship —

$\boxed{V_1N_1 = V_2N_2}$ [V_1 = Volume of $KMnO_4$, V_2 = Volume of Oxalic acid, N_1 = Normality of $KMnO_4$, N_2 = Normality of Oxalic acid]

Procedure:

1] Wash and rinse then fill the burette with given $KMnO_4$ sol^n, record initial reading (upper meniscus).

2] Pipette out 10 ml standard Oxalic acid sol^n in conical flask and add 2 drops of conc. H_2SO_4, heat it on wire gauze till the flask is unbearable to touch (temp~ 60°C)

3] Place the flask on clean surface and run the $KMnO_4$ sol^n slowly with constant shaking, the purple colour starts to discharge very slowly in the conical flask then it disappears rapidly.

4] Record final reading exactly when colourless solution turns to pinkish tinge. Repeat the procedure until 3 concordant readings are obtained.

Observations:

Sl no.	Initial reading	Final reading	Difference reading	Concordant reading
1	0	11.5	11.5	
2	11.5	23.0	11.5	11.5
3	23.0	34.4	11.4	

* Burette readings in ml

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Date 14/11/2023

Expt. No. _____ Page No. 07

Strength of Oxalic acid soln (N_2) = N/10 = 0.1 N

Volume of Oxalic acid for each titration (V_2) = 10 ml

Volume of $KMnO_4$ soln from burette reading (V_1) = 11.5 ml

Calculations: We have, $V_1N_1 = V_2N_2 \Rightarrow N_1 = \frac{V_2N_2}{V_1} \Rightarrow N_1 = \frac{10 \times 0.1}{11.5} = \frac{1}{11.5}$

$\Rightarrow N_1 = 0.086$ N

Result: The strength of given $KMnO_4$ soln is 0.086 N

The strength of $KMnO_4$ soln in g/L = Normality x Equivalent mass $= 0.086 \times \frac{158}{5}$

$= 0.086 \times 31.6$

$= 2.72$ g/L

21/11/23

Teacher's Signature _____

Date 28/11/2023

Expt. No. 06 Page No. 08

Aim : To determine the pH of a given acid or base solution having the following strengths –

i) 0.1 M NaOH ii) 0.01 M HCl

Requirements : a) Porcelain basin

b) pH paper

Theory :

1] **Physical method :** i) 2 ml sol^n is taken in test tube and pH paper is dipped in it.

ii) The colour of pH paper is observed and matched with colour range label.

pH (0–6) → acidic , pH (7–14) → basic , pH = 7 → neutral

2] **Calculation method :** i) pH is negative common log of Hydrogen or Hydronium ion in a solution & pOH is negative common log of Hydroxide ion in a solution

$$\boxed{pH = -\log_{10}[H^+] = -\log_{10}[H_3O^+]} \quad \& \quad \boxed{pOH = -\log_{10}[OH^-]}$$

ii) pH can be calculated According to Acid Base theory of pH scale,

$$\boxed{pH + pOH = 14}$$

Calculation :

a) **0.1 M NaOH**

Ionic equation of NaOH dissociation,

$$\underset{0.1\,M}{NaOH} \longrightarrow \underset{0.1\,M}{Na^+} + \underset{0.1\,M}{OH^-}$$

Now $pOH = -\log_{10}[OH^-] = -\log_{10}[0.1]$

$= -\log_{10}[10^{-1}] = \log_{10} 10$

$= 1$

$\therefore pOH + pH = 14$

$\Rightarrow pH = 14 - pOH = 14 - 1$

$\Rightarrow pH = 13$ //

b) **0.1 M HCl**

Ionic dissociation of HCl. dissociation,

$$HCl \longrightarrow H^+ + Cl^-$$

0.01M 0.01 M 0.01M

$\therefore pH = -\log_{10}[H^+]$

$= -\log_{10}[0.01]$

$= -\log_{10} 10^{-2}$

$= 2 \log_{10} 10$

$= 2$ //

Result : The pH of the given 0.1 M NaOH sol^n is 13 and 0.01 M HCl is 2.

NaOH is basic and HCl is acidic.

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